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Mark Scheme (Results)

June 2022

Pearson BTEC Nationals
In Applied Science (31619H)
Unit 3: Science Investigation Skills

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Unit 3: Science Investigation Skills

General marking guidance

- All learners must receive the same treatment. Examiners must mark the first learner in exactly the same way as they mark the last.
- Marking grids should be applied positively. Learners must be rewarded for what they have shown they can do, rather than be penalised for omissions.
- Examiners should mark according to the marking grid, not according to their perception of where the grade boundaries may lie.
- All marks on the marking grid should be used appropriately.
- All the marks on the marking grid are designed to be awarded. Examiners should always award full marks if deserved. Examiners should also be prepared to award zero marks, if the learner's response is not rewardable according to the marking grid.
- Where judgement is required, a marking grid will provide the principles by which marks will be awarded.
- When examiners are in doubt regarding the application of the marking grid to a learner's response, a senior examiner should be consulted.

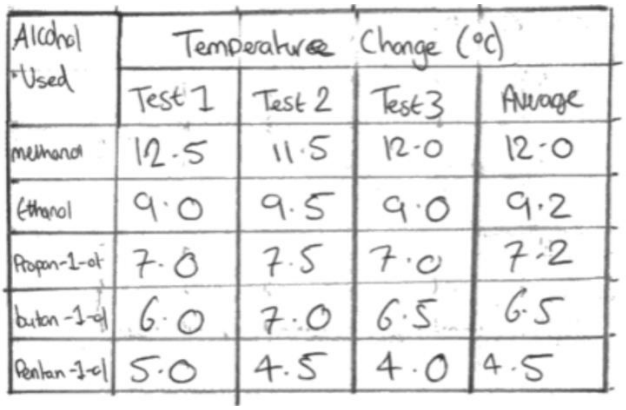
Specific marking guidance

The marking grids have been designed to assess learner work holistically. Rows in the grids identify the assessment focus/outcome being targeted. When using a marking grid, the 'best fit' approach should be used.

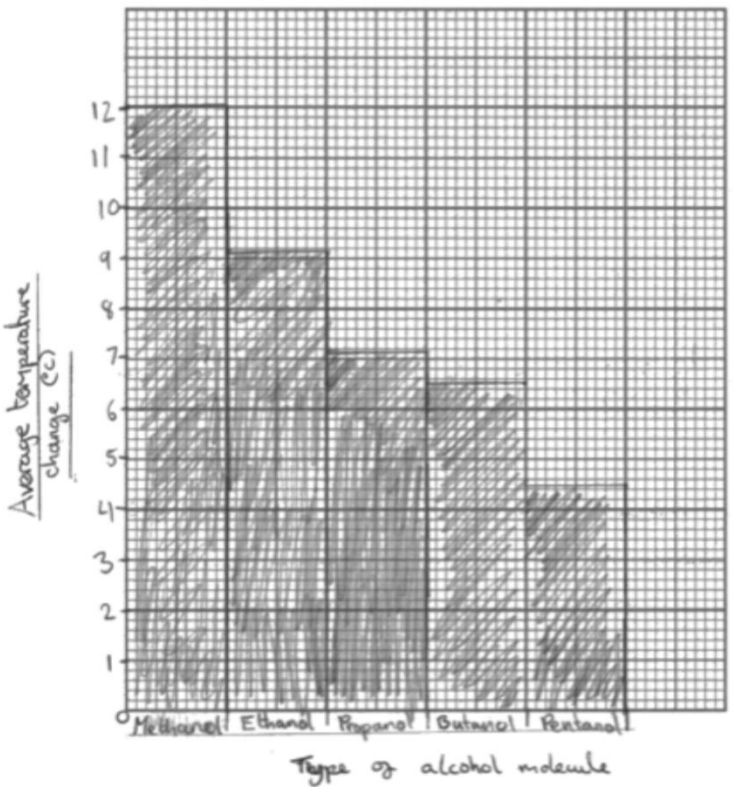
- Examiners should first make a holistic judgement on which band most closely matches the learner's response and place it within that band. Learners will be placed in the band that best describes their answer.
- The mark awarded within the band will be decided based on the quality of the answer, in response to the assessment focus/outcome and will be modified according to how securely all bullet points are displayed at that band.
- Marks will be awarded towards the top or bottom of that band, depending on how they have evidenced each of the descriptor bullet points.

BTEC Next Generation Mark Scheme 2206

Section 1 - Chemistry

Question Number	Answer	Additional Guidance	Mark
1 (a)	Results table containing: • suitable headings for type of alcohol, temperature change and average with units for temperature change and average (1) • means calculated correctly (1) • results **and** means recorded to the same number of decimal places (1) 	allow number of carbons as a heading allow units in **all** cells in table observations are not required in a table but may be included	3

Alcohol Used	Temperature Change (°C)			
	Test 1	Test 2	Test 3	Average
methanol	12.5	11.5	12.0	12.0
Ethanol	9.0	9.5	9.0	9.2
Propan-1-ol	7.0	7.5	7.0	7.2
butan-1-ol	6.0	7.0	6.5	6.5
Pentan-1-ol	5.0	4.5	4.0	4.5

Question Number	Answer	Additional Guidance	Mark
1 (b)	• labels and units for axes (1)	allow axes either way around allow 'number of carbons' or 'name of alcohol' for x axis	3
	• suitable scale for temperature change axis (1)	allow axis break spread of data covers half of graph paper on Y axis	
	• bars drawn correctly (1) 	if numbers on y axis are taken directly from the table in the order of the table then allow a maximum of 1 mark for the labels and units if line graph drawn allow max 2 marks for MP1 and MP2	

Question Number	Answer	Additional Guidance	Mark
1 (c)	as the number of carbon atoms increases the temperature change (of the water) decreases / ORA	allow as the temperature decreases the number of carbon atoms increases ignore negative correlation alone	1

Question Number	Answer	Additional Guidance	Mark
1 (d)	the data is {discrete/not continuous}/ partial carbon atoms do not exist	allow line graphs are used for continuous data allow data is categoric	1

Question Number	Answer	Additional Guidance	Mark
1 (e)(i)	burns (to technician)	allow set light to hair / clothes	1

Question Number	Answer	Additional Guidance	Mark
1 (e)(ii)	any one linked precaution from: light wick with long splint clear any spills immediately / ensure when refilling the burner there is no alcohol on the outside of the bottle place cap on burner {immediately after experiment / when not using it} allow alcohol burner to cool at end of experiment before picking up	ignore generic laboratory rules, e.g. tuck chairs under tables allow tie hair up	1

Question Number	Answer	Additional Guidance	Mark
1 (f)	carbon/soot (1) incomplete combustion of alcohol / insufficient oxygen present during burning (1)	 ignore pentanol has the most carbons	2

Question Number	Answer	Additional Guidance	Mark
1 (g)(i)	Allow two marks for 0.625 with or without working. (1/2 =) 0.5 (1) 0.5/80 x 100 = 0.625 (1)	allow 0.6 / 0.62 / 0.63 allow ecf 1.25% gains 1 mark	2

Question Number	Answer	Additional Guidance	Mark
1 (g)(ii)	(bulb/volumetric/graduated) pipette/burette	do not allow dropping pipette allow syringe	1

Question Number	Answer	Additional Guidance	Mark
1 (g)(iii)	to ensure the heat is evenly distributed throughout the water/so there are no 'hot spots' / OWTTE	reject temperature for heat	1

Question Number	Answer	Additional Guidance	Mark
1 (g)(iv)	final temperature (of water) – initial temperature (of water) / calculate difference between final and initial temperature (1)		1

Question Number	Answer	Additional Guidance	Mark
2 (a)(i)	An explanation linking any 2 from: to stop draught (1) so that flame stays under calorimeter/ flame does not go out (1) to reduce heat loss (1)	 allow to stop wind	2

Question Number	Answer	Additional Guidance	Mark
2 (a)(ii)	metal is a better conductor (of heat energy) than glass / glass is an {insulator /does not conduct (heat energy) as well}/ metal is a good conductor (of heat energy) (1) so more {heat /energy} transferred (to water) / ORA (1)	allow metal is a faster conductor of heat ignore so glass will not break	2

Question Number	Answer	Additional Guidance	Mark
2 (b)(i)	Allow two marks for 4410 with or without working. <u>Substitution (1)</u> 50 x 4.2 x 21 <u>Evaluation (1)</u> = 4410 Unit (1) J/joules	allow three marks for 4.41 **kJ** with or without working. allow ECF	3

Question Number	Answer	Additional Guidance	Mark
2 (b)(ii)	Any one pair from: stopped stop clock too early / started stop clock too late (1) therefore, less time for the heat to be transferred / less heat could be transferred (1) OR took thermometer out of water to read it (1) therefore, thermometer cooled down (1) OR flame was not directly under calorimeter (1) therefore, heat was not transferred to water / more heat loss to surroundings (1) OR calorimeter further away from the {flame / wick} (1) so more heat loss to surroundings (1) OR more water was in calorimeter (1) therefore, it will take longer to heat up (1) OR did not stir water (1) all heat concentrated at bottom of calorimeter (1) **Allow any other valid response.**	do not allow flame went out/ draughts	2

Question Number	Answer	Mark
2 (b)(iii)	**D** butan-1-ol	1

Question Number	Answer	Additional Guidance	Mark
2 (b)(iv)	0.29 on answer line scores 5 marks with or without working	allow 0.2915475947 rounded to two or more decimal places	5
	for each number subtract the mean (1)	8.0 – 7.8 = 0.2 7.5 – 7.8 = (–)0.3 8.0 – 7.8 = 0.2	
	and square the results (1)	0.2^2 = 0.04 $(-)0.3^2$ = 0.09 0.2^2 = 0.04	
	add up these values (1)	0.17	
	and divide by one less than the sample number (1)	$\frac{0.17}{2}$ = 0.085	
	square root this number to get the standard deviation (1)	√0.085 = 0.2915475947 allow ECF at any stage	

Question Number	Answer	Additional Guidance	Mark
3 (a)	Allow any **two** pairs same volume of water / 80 cm^3 (1) use a measuring cylinder each time (1) OR control the distance between conical flask and flame / keep conical flask 1.5 cm away from wick (1) clamp the conical flask in same position / use a ruler to measure the distance (1) OR same size flame / wick is same {length/width/size} (1) measure (wick) using a ruler (1) OR ensure heat is distributed though the water evenly each time (1) stir the same amount of times/at same speed (1) Accept any other valid response.	ignore time the water was heated for allow 50 cm^3	4

Question Number	Answer	Additional Guidance	Mark
3 (b)	Allow any two pairs measure the mass of alcohol burned (1) so you can calculate the heat energy released per gram of fuel/so that you can see how much fuel is needed (1) OR burn the fuels for a different length of time (1) to see if there is a maximum temperature change (1) OR calculate the relative formula mass of each of the alcohols (1) so that the heat energy per mol of alcohol can be determined (1) OR (use alcohol to) heat a different liquid (1) to see if all liquids are heated in the same way (1) OR use other alcohols (with a higher number of carbons) (1) to see if the trend continues or increases (1) OR use different (flammable) liquids containing an increasing number of carbons (1) to see if decrease is due to number of carbons (1) Accept any other valid response.	allow named flammable liquid ignore change type of hydrocarbon fuel	4

Section 2 - Biology

Question Number	Indicative content
4	A plan that makes reference to: • a hypothesis/prediction/ null hypothesis ○ e.g. there would be a greater population of dandelions in an south facing field as there should be more sunlight throughout the year compared to a north facing field. ○ link to photosynthesis ○ or any other suitable factor • equipment, techniques and/or procedures ○ e.g. equipment - quadrat - string and posts, or other way of dividing an area into a grid with numbered coordinates - random number generator. ○ method grid quadrats - divide north facing field, or a plan of it, into a grid, for instance, having 10 × 10 divisions - generate pairs of random numbers and use these as coordinates on your grid - place the first quadrat in the field at one of the coordinates - count the number of dandelions within this quadrat - repeat steps 2–4, with 9 different coordinates so that you have a total of at least 10 counts - repeat steps 1–5 for the south facing field. OR line transect - in the north facing field marking starting point - use string to give a straight line through the field - drop quadrat at the starting point - count the dandelions in the quadrat - move the quadrat 1 m along the string line - count the dandelions - repeat along the length of the string - repeat for the south facing field. • risks and hazards ○ nettles and other poisonous flora ○ insects ○ uneven ground ○ sunburn ○ allergies. • control variables ○ size of quadrat ○ classification of dandelion

	○ method of counting with regards to inclusion dependant variable ○ density dandelions/number of dandelions per m^2 • independent variable – the range of measurements/categories to be used and how they will be measured, the intervals to take measurements ○ location (north or south facing). • dependent variables – how it will be measured, units and the precision of measurements to be taken ○ number of dandelions. • data analysis ○ indication of how the data will be presented - e.g. complete a table of the results - calculate a mean value for dandelions per m^2 for each area - represent as bar chart/histogram - carry out a statistical analysis

Mark scheme (award up to 12 marks) Refer to the general marking guidance found in this document on how to apply levels-based mark schemes.		
Level	Mark	Descriptor
Level 0	0	No awardable content.
Level 1	1–3	• Limited attempt at a hypothesis is made. • Demonstrates limited knowledge and understanding of scientific concepts, procedures, processes and techniques with a basic description of the plan to investigate the scientific scenario given. • Provides a rationale for the method suggested and generic statements may be presented rather than linkages being made so that lines of scientific reasoning are unsupported or unclear. • The plan will not be logically ordered with significant gaps that will not lead to reliable results being collected.
Level 2	4–6	• An explanation for the hypothesis is given which is partially supported by scientific understanding. • Demonstrates adequate knowledge and understanding of scientific concepts, procedures, processes and techniques with a partial description of the plan to investigate the scientific scenario given. • Provides a rationale for the method which has occasional linkages present so that lines of scientific reasoning are partially supported. • The plan will generally be in a logical sequence and will yield some results.
Level 3	7–9	• An explanation for the hypothesis is given which is supported by scientific understanding. • Demonstrates good knowledge and understanding of scientific concepts, procedures, processes and techniques with a clear description of the plan to investigate the scientific scenario given. • Provides a rationale for the method which has linkages present so that lines of scientific reasoning are supported. • The plan will be in a logical sequence but with minor omissions of steps and will yield reliable results.
Level 4	10–12	• An explanation for the hypothesis is given which is fully supported by scientific understanding. • Demonstrates comprehensive knowledge and understanding of scientific concepts, procedures, processes and techniques with a step by step description of the plan to investigate the scientific scenario given. • Provides a rationale for the method which has consistent linkages present so that lines of scientific reasoning are fully supported. • The plan will be in a logical sequence and will lead to a reliable set of results being collected.
		Total marks for Question 4 = 12 marks

Question Number	Indicative content
5	An evaluation that makes reference to: method e.g. • size of quadrat not given • size of area not given • quadrat shouldn't be slid or dropped as this could damage the plants and could affect the results • distance between the sampling points unknown • time of year/ day not given • effect of weather unknown • abiotic factors not stated/considered • could use belt transect instead of line transect. Results e.g. • no repeats • no unit for the distance • no unit for daisies – e.g. per m^2/per quadrat • not clear if all results up to B have been given. Conclusion e.g. • overall, there is positive correlation • there is an anomalous result o e.g. distance 3 is an anomalous result if the conclusion is correct o distance 2 could be too high • there may be some biotic or abiotic factor/example of a factor at 3 which reduces daisy numbers or • as it is biological sampling there might not be anomalous results, another factor could be the true value, and there is no relationship

Mark scheme (award up to 8 marks) Refer to the general marking guidance found in this document on how to apply levels-based mark schemes.		
Level	Mark	Descriptor
	0	No awardable content.
Level 1	1–2	• Adequate interpretation and analysis of the scientific information. • Generic evaluative comments made with little linkage to supporting evidence/reference to context. • A conclusion may be presented but will lack focus and be superficial and underdeveloped.
Level 2	3–5	• Good analysis and interpretation of the scientific information. • Evaluative comments with supporting evidence/reference to context and a partially developed chain of reasoning. • Conclusion will be mostly focused and developed and draw upon some of the information presented before.
Level 3	6–8	• Comprehensive analysis and interpretation of all pieces of scientific information. • Evaluative comments supported by relevant reasoning and appropriate reference to context. • Conclusion will be clear and concise and well-developed drawing upon the most relevant information presented before.
		Total marks for Question 5 = 8 marks

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